



**Fermi National Accelerator Laboratory
Batavia, IL 60510**

LARGE HADRON COLLIDER YOKE & SKINNING ASSEMBLY TRAVELER

**Reference Drawing(s):
Skinned Yoke Assembly
5520-ME-369579
Final Long Cold Mass Assembly
5520-ME-369578**

JUL 10 2002

Scannable Pages

49

Budget Code: <u>LPT</u>	Project Code: <u>LHC</u>	
Released by: <u>[Signature]</u>	Date: <u>10/4/01</u>	
Prepared by: M. Cullen, J. Larson,		
Title	Signature	Date
TD / E&F Process Engineering	<u>[Signature]</u> Bob Jensen/Designee	<u>10/4/01</u>
TD / LHC Production Supervisor	<u>[Signature]</u> Jim Hite/Designee	<u>10/5/01</u>
TD / LHC Production Engineer	<u>[Signature]</u> Rodger Bossert/Designee	<u>10/5/01</u>
TD / LHC Tooling Engineer	<u>[Signature]</u> John Carlson/Designee	<u>10/5/01</u>
TD / LHC Program Manager	<u>[Signature]</u> Jim Kerby/Designee	<u>10/5/01</u>

Revision Page

Revision	Step No.	Revision Description	TRR No.	Date
None	N/A	Initial Release	N/A	11/29/00
	4.6 / 4.9 / 5.3	Change Drawing to 32 Loose Laminations and 1 5/8" for the Wires	1224	10/4/01
	4.7 / 4.8 / 4.9	Moved to after 4.10		
	6.0	Removed all Strain Gauge Measurements. Added R, Ls and Q measurements for the magnet Before Pressing and After. Tac Weld the Skin and Keys After pressing and electrical inspection.		
	7.0	Removed all Strain Gauge Measurements.		
	8.2	Change from 1.221" to 2.221".		
	8.7	Change to Return End.		
	9.3	Angle measured in .001 mm / m = 0.2 sec		
	10.0	Combine step 9.0 and 10.0.		
	9.7	Update the electrical inspection form.		

Ensure appropriate memos and specific instructions are placed with the traveler before issuing the sub traveler binder to production.

1.0 General Notes

- 1.1 White (Lint Free) Gloves (Fermi stock 2250-1800) or Surgical Latex Gloves (Fermi stock 2250-2494) shall be worn by all personnel when handling all product parts after the parts have been prepared/cleaned.
- 1.2 All steps that require a sign-off shall include the Technician/Inspectors first initial and full last name.
- 1.3 No erasures or white out will be permitted to any documentation. All incorrectly entered data shall be corrected by placing a single line through the error, initial and date the error before adding the correct data.
- 1.4 All Discrepancy Reports issued shall be recorded in the left margin next to the applicable step.
- 1.5 All personnel performing steps in this traveler must have documented training for this traveler and associated operating procedures.
- 1.6 Personnel shall perform all tasks in accordance with current applicable ES&H guidelines and those specified within the step.
- 1.7 Cover the product/assembly with green Herculite (Fermi stock 1740-0100) when not being serviced or assembled. Completed wedges are to be stored in the LHC Coil Storage Area.

2.0 Parts Kit List

- 2.1 Attach the completed Parts Kit List for the LHC Yoke/Skinning Assembly to this traveler. Ensure that the serial number on the Parts Kit List matches the serial number of this traveler. Verify that the Parts Kit received is complete.



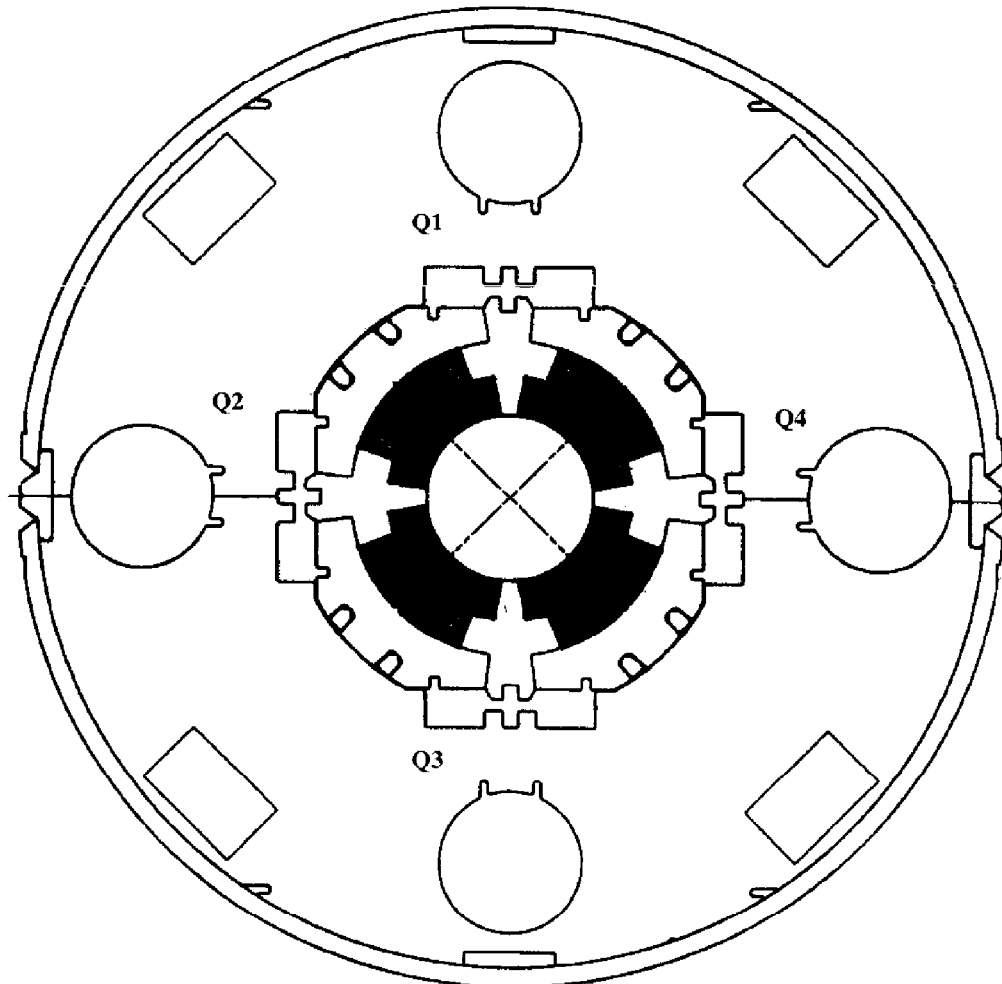
Process Engineering/Designee



Date

SKINNED YOKE ASSEMBLY 5520-ME-369579
(View from Lead End of center cross section)

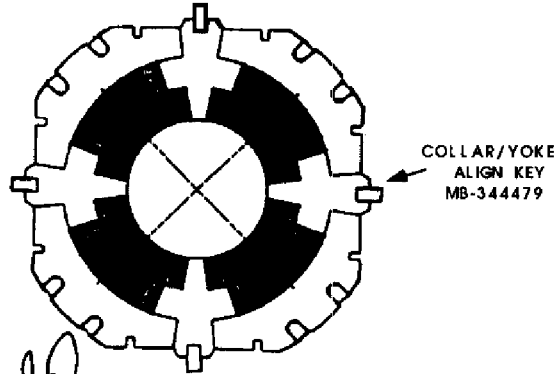
Top



Bottom

3.0 Preparation

- 3.1 Install the Collar/Yoke Alignment Keys (MB-344479) into all four sides of the Collared Coil Assembly as shown below.



TE & 12/12/01
Are prepared
with 10/12/01
properly
Revised

[Signature]
 Technician(s)

10/12/01
 Date

- 3.2 Thoroughly clean the Lower Mold contact areas using Isopropyl Alcohol (Fermi stock 1920-0300) and a Lint Free Heavy Duty Wipe (Fermi stock 1660-2600) or equivalent.

[Signature]
 Technician(s)

10/12/01
 Date

- 3.3 Remove and record two Lower Mold Side Plates from both sides of the Lower Mold

Plate # *8*
[Signature]
 Technician(s)

Plate # *14*
10/12/01
 Date

- X 3.4 Inspect the Mold at the contact areas to ensure it has a smooth surface without imperfections (nicks, burrs, contaminants, etc.), and verify the Lower Mold Side Plates have been removed.

SWG
[Signature]
 Crew Chief

10/12/01
 Date

4.0 Installing the Bottom of the Cold Mass

- 4.1 Clean the Bottom Skin (MD-369585) as per the Cleaning and Handling Standards for Stainless Steel Yoke Components (ES-292380).

[Signature]
Technician(s)

10/12/01
Date

- 4.2 Transport and place the Bottom Skin (MD-369585) in Lower Mold Assembly (MD-344361) as per the Skin Lifting Procedure (ES-293859).

[Signature]
Technician(s)

10/12/01
Date

- 4.3 Install the Lower Mold Side Plates that were removed in Step 3.5.

[Signature]
Technician(s)

10-12-01
Date

- 4.4 Prepare the Lower Yoke Packs for installation.

Note(s):

Roll over the Yoke Packs using the Rollover Fixture (FNAL 46245) with threaded rods.

Clean the Yoke Packs with Isopropyl Alcohol (Fermi stock 1920-0300) and Lint Free Heavy Duty Wipers (Fermi stock 1660-2600).

Title	Part #	Quantity	Cleaned	Rolled Over
Lead End Yoke Pack	ME-369587	1	1	✓
Lead End Straight Section Yoke Pack	ME-369588	1	1	✓
Straight Section Yoke Pack	ME-369727	2	2	✓
Return End Yoke Pack	ME-369589	1	1	✓
Filler Packs	No part No.	8	8	✓
Loose Laminations	ME-369279	32	32	

[Signature]
Technician(s)

10-17-01
Date

- X 4.5 Inspect the Lower Yoke Packs from step 4.4.

[Signature]
Lead Person

10/17/01
Date

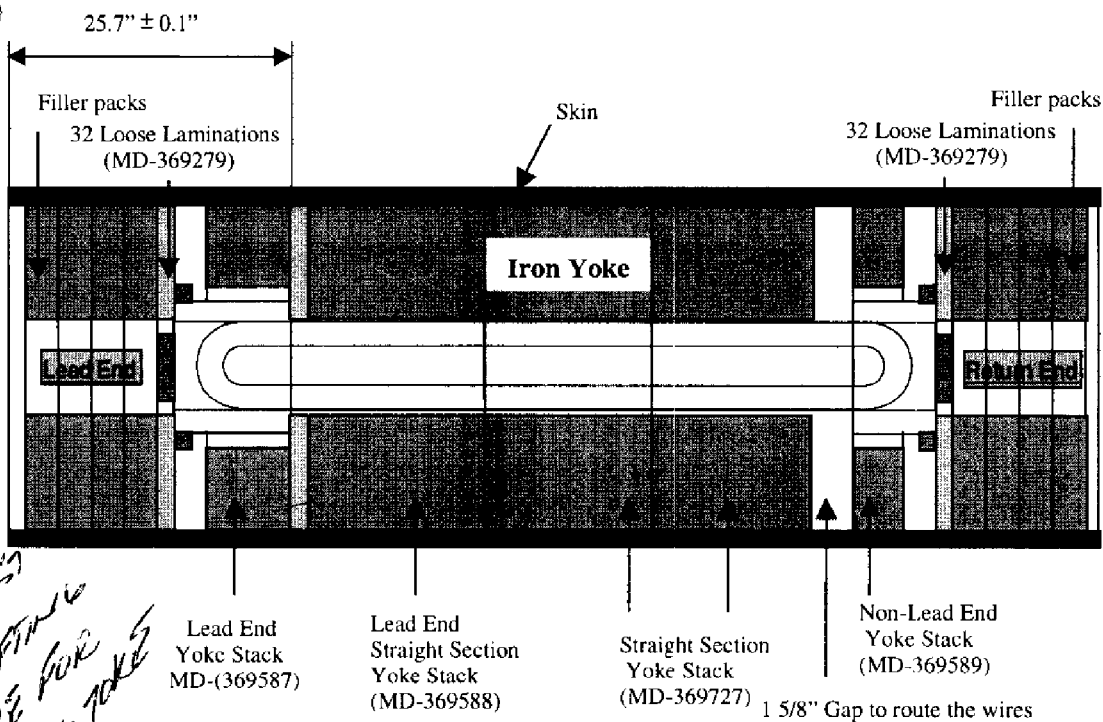
October 4, 2001

Rev. A

- 4.6 Insert the Lower Yoke Packs into the Bottom Skin in accordance with the Skinned Yoke Assembly (ME-369579).

Note(s):

Place the Lower Lead End Straight Section Yoke Packs in the Bottom Skin 25.7" from the end of the skin. Ensure all yoke packs are in contact, excluding the 2" gap for the wires.



*T.R.R. # 1252
USE LIFTING
FIXTURE FOR
INSTALLING
STACKS*

Technician(s)

10-17-01
Date

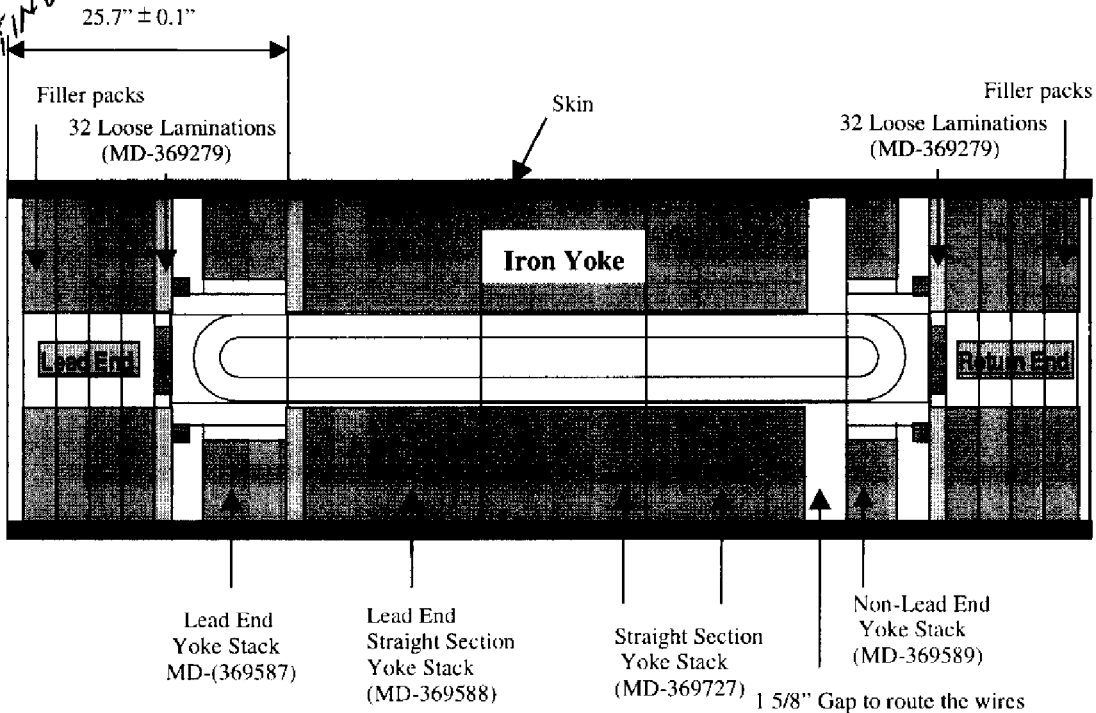
TRR 1252
REMOVE SKINNED
GAGE WIRES FROM
STEP
TRR #1257
SPECIFY UPPIING FIXTURE
FOR HOLDING COLLARED COIL

4.7

Install the Collared Coil so Quadrant #1 is on top as per the Skinned Yoke Assembly (MD-369579) and ensure that the Strain Gage Wires and Power Leads are free and clear.

Note(s):

Ensure that the Collared Coil Assembly is rotated so the Collared Coil \ Alignment Keys are vertical and horizontal. Quadrant #1 is up and the Collared Coil is in contact with the Lead End Straight Section Yoke Lamination Pack.



Lead End
Yoke Stack
MD-(369587)

Lead End
Straight Section
Yoke Stack
(MD-369588)

Straight Section
Yoke Stack
(MD-369727)

Non-Lead End
Yoke Stack
(MD-369589)

1 5/8" Gap to route the wires

Technician(s)

Date

October 4, 2001

Rev. A

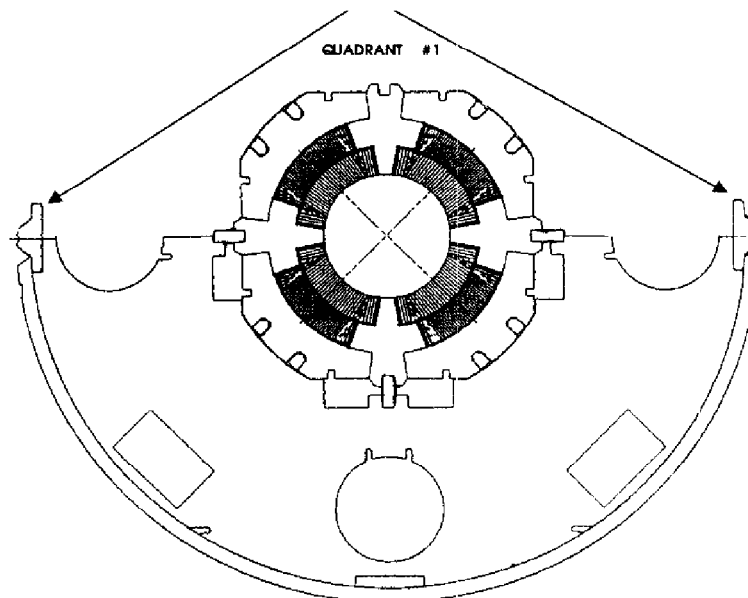
- 4.8 Clean the Skin Alignment Keys (MC-369586) as per the Cleaning and Handling Standards for Stainless Steel Yoke Components (ES-292380).

T. J. Koo
Technician(s)

10-18-01
Date

- 4.9 Install the Skin Alignment Keys (MC-369586) onto the Lower Yoke Assembly (ME-369579) (on both sides) as shown below.

Skin Alignment Keys (MC-369586)



T. J. Koo
Technician(s)

10-18-01
Date

- X 4.10 Verify the Lower Yoke Packs and Skin Alignment Keys are installed in the skin as per the Skinned Yoke Assembly (ME-369579).

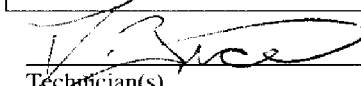
J. Gould
Inspector(s)

10/18/01
Date

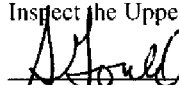
5.0 Installing the Top of the Cold Mass

- 5.1 Clean the Yoke Packs with Isopropyl Alcohol (Fermi stock 1920-0300) and Lint Free Heavy Duty Wipers (Fermi stock 1660-2600).

Title	Part #	Quantity	Cleaned
Lead End Yoke Pack	ME-369587	1	✓
Lead End Straight Section Yoke Pack	ME-369588	1	✓
Straight Section Yoke Pack	ME-369727	2	✓
Return End Yoke Pack	ME-369589	1	✓
Filler Packs	No part No.	8	✓
Loose Laminations	ME-369279	32	✓


Technician(s)10/18/01
Date

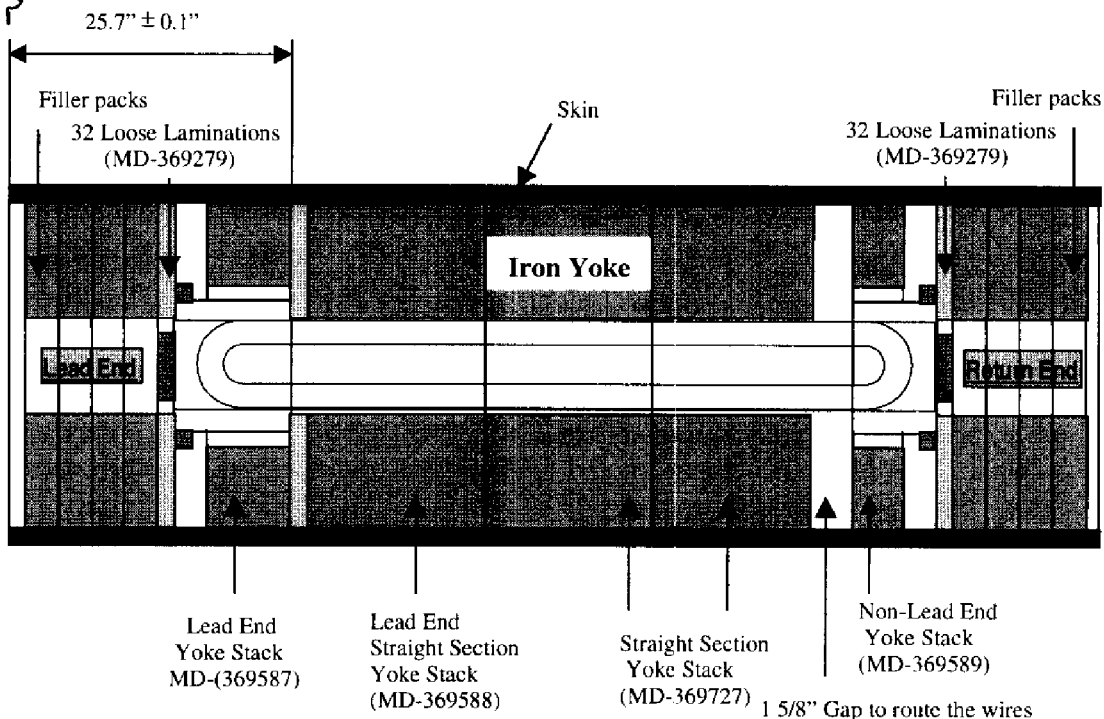
- X 5.2 Inspect the Upper Yoke Packs from step 5.1.


Lead Person10/18/01
Date

Install the Top Yoke Lamination Packs as per the Skinned Yoke Assembly (ME-369579).

Note(s):

Ensure that the Top Lead End Straight Section Yoke Lamination Pack is in contact with the Lead End Can and all Yoke Lamination Packs are in contact.



Technician(s)

Date

Transport and place the Top Skin (MD-369585) on the Bottom Yoke Lamination/Skin Assembly.

Technician(s)

Date

6.0 Pressing the Cold Mass

- 6.1 Roll Skin Assembly into press as per Yoke and Skin Press Operating Procedure (ES-301502).

Howe
Technician(s)10/18/01
Date

- X 6.2 Perform an Electrical Inspection of the Magnet.

	Nominal	Measurements
Resistance	2.3 Ω	2.304 Ω
Q @ 1 kHz	4.3	5.05
Inductance(Ls) @ 1 kHz	17 mH	13.2721 mH

Howe
Inspector10/18/01
Date

- 6.3 Verify that the Readings in Step 6.2 are acceptable
-
- Approved for next Major Assembly Procedure.

Ray R
Responsible Authority/Physicist10/18/01
Date

- 6.4 Energize the Press to 600 psi pump as per the Yoke and Skin Press Assembly Operating Procedure (ES-301502).

Howe
Technician(s)10/23/01
Date

- 6.5 Tac Weld the Skin and Keys.

Michael P. Lyman
Technician(s)10/23/01
Date

- 6.6 Perform an Electrical Inspection of the Magnet.

	Nominal	Measurements
Resistance	2.3 Ω	2.302 Ω
Q @ 1 kHz	4.3	5.15
Inductance(Ls) @ 1 kHz	17 mH	13.2736 mH

Howe
Inspector10/23/01
Date

- 6.7 Verify that the Readings in Step 6.6 are acceptable
-
- Approved for next Major Assembly Procedure.

Ray R
Responsible Authority/Physicist10/23/01
Date

TRR # 1256
CHECK & UPDATE
NOMINALS HERE +
STEP 7.23



TRR # 1256
TACK WELD
EVERY OTHER
PRESS COLUMN
BEHIND LINE
COLUMN AT LE.



7.0 Welding the Cold Mass

- 7.1 Measure the Gap between the upper and lower support plates at 21 1' intervals on the north and south side.

South			North		
1- 2.289 2.43	8 2.291	15- 2.2965	1- 2.3105	8 2.296	15- 2.290
2- 2.2915	9- 2.2955	16- 2.2915	2- 2.301	9- 2.290	16- 2.295
3- 2.2985	10- 2.2905	17- 2.2915	3- 2.2965	10- 2.2955	17- 2.290
4- 2.298	11- 2.2945	18- 2.2945	4- 2.309	11- 2.296	18- 2.286
5- 2.2975	12- 2.2965	19- 2.288	5- 2.3005	12- 2.290	19- 2.2905
6- 2.3015	13- 2.2905	20- 2.2885	6- 2.2965	13- 2.298	20- 2.282
7- 2.2925	14- 2.2925	21- 2.2935	7- 2.305	14- 2.2915	21- 2.284

[Signature]
Inspector(s)

10/23/01
Date

- 7.2 Refer to the LHC Yoke/Skinning Welding Procedure (ES-344959). Perform the Fusion Pass, on the cold mass, as per the Skinned Yoke Assembly (ME-369579).

[Signature]
Welder(s)

10/23/01
Date

- 7.3 Clean the welds using Stainless Steel Wire Brush (Fermi stock 1246-0860), Vacuum, Isopropyl Alcohol (Fermi stock 1920-0300) and Kimwipes (Fermi stock 1660-2500) or equivalent to remove any and all dirt and foreign materials.

[Signature]
Technician(s)

10/23/01
Date

- 7.4 Measure the Gap between the upper and lower support plates at 21 1' intervals on the north and south side.

South			North		
1- 2.264	8- 2.2285	15- 2.2335	1- 2.2785	8- 2.235	15- 2.2285
2- 2.2385	9- 2.2345	16- 2.225	2- 2.251	9- 2.2275	16- 2.235
3- 2.2435	10- 2.2185	17- 2.2295	3- 2.2405	10- 2.2365	17- 2.2285
4- 2.2395	11- 2.225	18- 2.234	4- 2.2575	11- 2.235	18- 2.2265
5- 2.2345	12- 2.240	19- 2.228	5- 2.236	12- 2.225	19- 2.2345
6- 2.248	13- 2.2275	20- 2.241	6- 2.2375	13- 2.238	20- 2.239
7- 2.2315	14- 2.2265	21- 2.274	7- 2.236	14- 2.2325	21- 2.264

J. H. H. H.
Inspector(s)

10/23/01
Date

- 7.5 Refer to the LHC Yoke/Skinning Welding Procedure (ES-344959). Perform Filler Pass #1, on the cold mass, as per the Skinned Yoke Assembly (ME-369579).

Michael P. Kyns
Welder

10/23/01
Date

- 7.6 Clean the welds using Stainless Steel Wire Brush (Fermi stock 1246-0860), Vacuum, Isopropyl Alcohol (Fermi stock 1920-0300) and Kimwipes (Fermi stock 1660-2500) or equivalent to remove any and all dirt and foreign materials.

J. H. H. H.
Technician(s)

10/23/01
Date

- 7.7 Measure the Gap between the upper and lower support plates at 21 1' intervals on the north and south side.

South			North		
1- 2.235	8- 2.1665	15- 2.173	1- 2.2575	8- 2.174	15- 2.169
2- 2.196	9- 2.1675	16- 2.1695	2- 2.211	9- 2.1695	16- 2.1725
3- 2.187	10- 2.162	17- 2.167	3- 2.189	10- 2.183	17- 2.170
4- 2.1785	11- 2.1665	18- 2.17	4- 2.1965	11- 2.1755	18- 2.169
5- 2.1735	12- 2.1745	19- 2.174	5- 2.1805	12- 2.169	19- 2.1835
6- 2.1835	13- 2.164	20- 2.195	6- 2.181	13- 2.1785	20- 2.1925
7- 2.173	14- 2.1675	21- 2.24	7- 2.186	14- 2.171	21- 2.243

J. H. H. H.
Inspector(s)

10/23/01
Date

- 7.8 Refer to the LHC Yoke/Skinning Welding Procedure (ES-344959). Perform Filler Pass #2, on the cold mass as per the Skinned Yoke Assembly (ME-369579).

Weldor(s)

Date

- 7.9 Clean the welds using Stainless Steel Wire Brush (Fermi stock 1246-0860), Vacuum, Isopropyl Alcohol (Fermi stock 1920-0300) and Kimwipes (Fermi stock 1660-2500) or equivalent to remove any and all dirt and foreign materials.

Technician(s)

Date

- 7.10 Measure the Gap between the upper and lower support plates at 21 1' intervals on the north and south side.

South			North		
1- 2.2207	8- 2.1135	15- 2.123	1- 2.2295	8- 2.125	15- 2.1225
2- 2.1585	9- 2.1195	16- 2.115	2- 2.179	9- 2.124	16- 2.1305
3- 2.1475	10- 2.1165	17- 2.1165	3- 2.1475	10- 2.1305	17- 2.126
4- 2.125	11- 2.115	18- 2.123	4- 2.149	11- 2.1295	18- 2.124
5- 2.175	12- 2.135	19- 2.126	5- 2.1338	12- 2.121	19- 2.146
6- 2.1305	13- 2.1145	20- 2.157	6- 2.132	13- 2.128	20- 2.165
7- 2.1155	14- 2.1155	21- 2.2165	7- 2.1375	14- 2.123	21- 2.227

Inspector(s)

Date

- 7.11 Refer to the LHC Yoke/Skinning Welding Procedure (ES-344959). Perform Filler Pass #3, on the cold mass as per the Skinned Yoke Assembly (ME-369579).

Weldor(s)

Date

- 7.12 Clean the welds using Stainless Steel Wire Brush (Fermi stock 1246-0860), Vacuum, Isopropyl Alcohol (Fermi stock 1920-0300) and Kimwipes (Fermi stock 1660-2500) or equivalent to remove any and all dirt and foreign materials.

Technician(s)

Date

- 7.13 Measure the Gap between the upper and lower support plates at 21 1' intervals on the north and south side.

South			North		
1- 2.1925	8- 2.076	15- 2.0815	1- 2.2255	8- 2.088	15- 2.091
2- 2.135	9- 2.0795	16- 2.0805	2- 2.1575	9- 2.089	16- 2.0945
3- 2.1135	10- 2.0715	17- 2.0785	3- 2.1205	10- 2.097	17- 2.095
4- 2.0915	11- 2.078	18- 2.084	4- 2.1155	11- 2.092	18- 2.0945
5- 2.087	12- 2.0855	19- 2.093	5- 2.1	12- 2.086	19- 2.118
6- 2.091	13- 2.077	20- 2.128	6- 2.0995	13- 2.0905	20- 2.1415
7- 2.078	14- 2.078	21- 2.1865	7- 2.099	14- 2.09	21- 2.2055

Inspector(s)

Date

- 7.14 Refer to the LHC Yoke/Skinning Welding Procedure (ES-344959). Perform Filler Pass #4, on the cold mass, as per the Skinned Yoke Assembly (ME-369579).

Welder(s)

Date

- 7.15 Clean the welds using Stainless Steel Wire Brush (Fermi stock 1246-0860), Vacuum, Isopropyl Alcohol (Fermi stock 1920-0300) and Kimwipes (Fermi stock 1660-2500) or equivalent to remove any and all dirt and foreign materials.

Technician(s)

Date

- 7.18 Measure the Gap between the upper and lower support plates at 21 1' intervals on the north and south side.

South			North		
1- 2.1815	8- 2.0485	15- 2.064	1- 2.2145	8- 2.066	15- 2.071
2- 2.1195	9- 2.056	16- 2.055	2- 2.1465	9- 2.0625	16- 2.078
3- 2.095	10- 2.043	17- 2.055	3- 2.106	10- 2.07	17- 2.076
4- 2.0685	11- 2.052	18- 2.06	4- 2.1095	11- 2.0735	18- 2.073
5- 2.065	12- 2.065	19- 2.07	5- 2.081	12- 2.0635	19- 2.0975
6- 2.0695	13- 2.0525	20- 2.1095	6- 2.073	13- 2.078	20- 2.1285
7- 2.049	14- 2.055	21- 2.175	7- 2.0725	14- 2.0725	21- 2.1995

Inspector(s)

Date

- 7.19 Refer to the LHC Yoke/Skinning Welding Procedure (ES-344959). Perform Filler Pass #5, on the cold mass, as per the Skinned Yoke Assembly (ME-369579).

Welder(s)

Date

- 7.20 Clean the welds using Stainless Steel Wire Brush (Fermi stock1246-0860), Vacuum, Isopropyl Alcohol (Fermi stock1920-0300) and Kimwipes (Fermi stock1660-2500) or equivalent to remove any and all dirt and foreign materials.

Technician(s)

Date

- 7.21 Measure the Gap between the upper and lower support plates at 21 1' intervals on the north and south side.

South			North		
1- 2.172	8- 2.028	15- 2.0405	1- 2.202	8- 2.0465	15- 2.053
2- 2.107	9- 2.0355	16- 2.035	2- 2.131	9- 2.043	16- 2.0585
3- 2.078	10- 2.0245	17- 2.036	3- 2.1875	10- 2.05	17- 2.0575
4- 2.053	11- 2.0295	18- 2.0415	4- 2.0765	11- 2.053	18- 2.06
5- 2.044	12- 2.037	19- 2.0575	5- 2.06	12- 2.0435	19- 2.086
6- 2.047	13- 2.033	20- 2.049	6- 2.053	13- 2.053	20- 2.1285
7- 2.0245	14- 2.0355	21- 2.1645	7- 2.0515	14- 2.053	21- 2.1915

Inspector(s)

Date

7.22 Release Press pressure and remove the cold mass from the press.

Technician(s)

Date

X 7.23 Perform an Electrical Inspection on the magnet.

	Nominal	Measurements
Resistance	2.3 Ω	2.328 Ω
Q @ 1 kHz	4.3	5.08
Inductance(Ls) @ 1 kHz	17 mH	13.2463 mH

Inspector

Date



7.24 Verify that the Readings in Step 7.23 are acceptable. Approved for next Major Assembly Procedure.

Responsible Authority/Physicist

Date

10/23/01

(L ^{PT} ~~PT~~)M. Reynolds
R. Williams

LH COLD MASS #MQT301

Double "5" Groove 2.5 I.P.M.

	AGC	% AMP	A. AMP	WIRE	
Rad	12.0	440	162	—	08:45
GREEN	12.0	440	169	—	
Blue	12.0	440	149	—	
Yellow	12.0/11.0	440/420	174	—	
10/24/01					
Rad	12.0	440	162	355	13:40 15:00
GREEN	12.0	440/450	173	300	
Blue	12.0	440	169	350	
Yellow	12.0	420/440	193	350	
10/24/01					
Rad	12.0	440	162	355	12:45 GREEN won't fire CAMARA coolant Pump won't Turn on.
GREEN	12.0	460	176	300	
Blue	12.0	440	172	350	
Yellow	12.0	480	202	300	
10/25					
Rad	12.0	450	165	350	2:30
GREEN	12.0	470	180	300	
Blue	12.0	450	172	350	
Yellow	12.0	470	202	300	
10/25					
Rad	12.0	449	165	350	08:45
GREEN	13.0	470/440	187	300	
Blue	12.0	450	158	350	
Yellow	12.0	470/440	186	300	

6th PASS

NORTH

- 1- 2.197
- 2- 2.118
- 3- 2.0795
- 4- 2.067
- 5- 2.0475
- 6- 2.0395
- 7- 2.0415
- 8- 2.0355
- 9- 2.033
- 10- 2.0435
- 11- 2.0415
- 12- 2.034
- 13- 2.047
- 14- 2.0405
- 15- 2.042
- 16- 2.046
- 17- 2.048
- 18- 2.056
- 19- 2.0795
- 20- 2.115
- 21- 2.1885

SOUTH

- 1- 2.167
- 2- 2.098
- 3- 2.068
- 4- 2.043
- 5- 2.029
- 6- 2.0295
- 7- 2.0155
- 8- 2.014
- 9- 2.023
- 10- 2.011
- 11- 2.019
- 12- 2.035
- 13- 2.0185
- 14- 2.02
- 15- 2.0215
- 16- 2.0205
- 17- 2.024
- 18- 2.0325
- 19- 2.0495
- 20- 2.092
- 21- 2.166

WELDS W. P. Ryals 10/25/01
 TECH A. Howard 10/25/01 - MEASUREMENTS
 CLEANED WELDS A. Howard 10/25/01

	AGC	% Amps	A. Amps	Wire
Red	12.0	45.0/270	17.2	225/240
Green	13.0	49.0/270	18.0	225/240
Blue	12.0	42.0	15.3	—
Yellow	12.0	44.0	26.6	280

Red	12.00	430	15.8	—
Green	13.00	430	16.6	—
Blue	12.0	430/400	15.4	124
Yellow	12.0	430/310	16.9	050

any control needs
adjustment

8.0 Cutting the Cold Mass Skin to Length

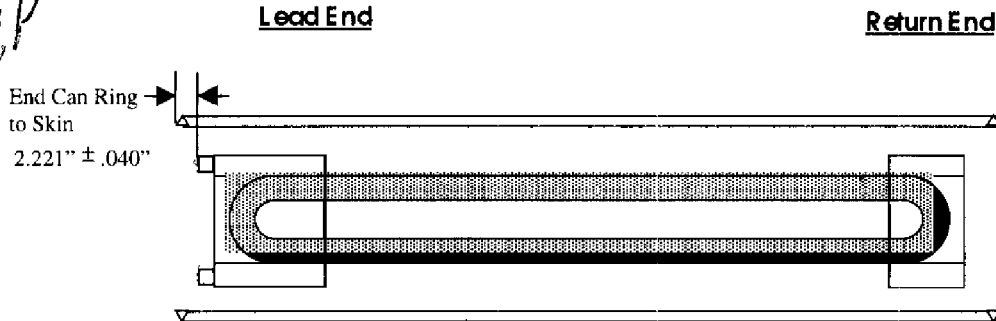
8.1 Remove the same Lower Mold Side Plates as in step 3.5. Lift the Cold Mass using approved and appropriate lifting procedures and transport to the Skin Cutting Station.

*TRR#256
move this
step to after
step 7.22*

[Signature]
Technician(s)

10/26/01
Date

8.2 Mark the Lead End of the Cold Mass Skin as shown in the figure below.



[Signature]
Technician(s)

10/26/01
Date

X 8.3 Verify that the Lead End of the Cold Mass has been marked and the Wachs Cutter is placed in the proper location.

[Signature]
Crew Chief

10/26/01
Date

8.4 Cut the Lead End of the Cold Mass to the proper length using the Wachs Cutter as per the Skinned Yoke Assembly (ME-369579).

Note(s):

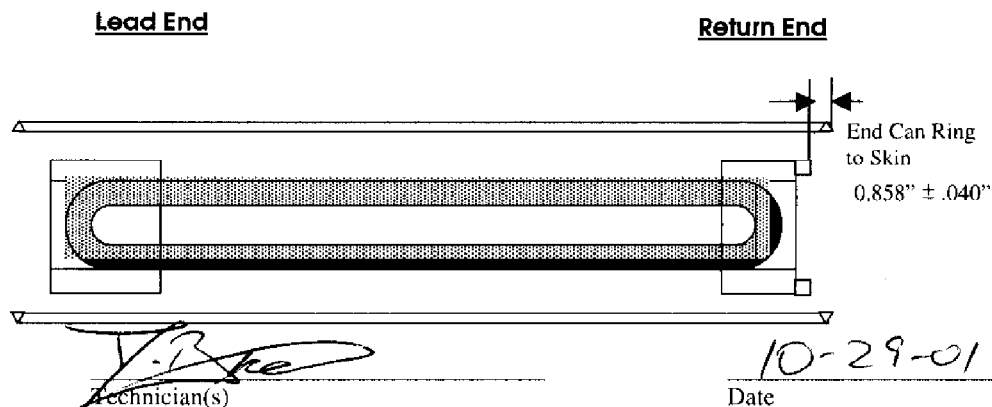
While cutting or filing ensure that all exposed parts are covered and a vacuum is used during the process to collect all debris.

Make two cuts, first a rough-cut 1" away from mark, and final cut at the mark.

[Signature]
Lead Person

10-29-01
Date

- 8.5 Mark the Return End of the Cold Mass Skin as shown in Figure below



- X 8.6 Verify that the Return End of the Cold Mass has been marked and the Cutting Fixture is placed in the proper location.

Crew Chief

Date 10/29/01

- X 8.7 Cut the Return End of the Cold Mass to the proper length using the Wachs Cutter as per the Skinned Yoke Assembly (ME-369579).

Note(s):

While cutting or filing ensure that all exposed parts are covered and a vacuum is used during the process to collect all debris.

Make two cuts, first a rough-cut 1" away from mark, and final cut at the mark.

Lead Person

Date 10-30-01

- 8.8 Remove any loose yoke laminations from the ends.

Technician(s)

Date 10-30-01

- X 8.9 Stamp the Magnet Serial Number on both ends of the Cold Mass Skin in 1/2" high numbers/letters approximately 3 inches above the Alignment Key.

1"

Lead End

Cold Mass Assembly

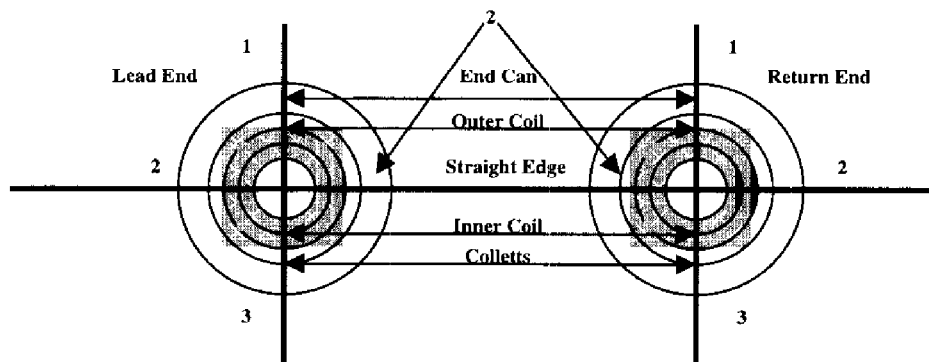
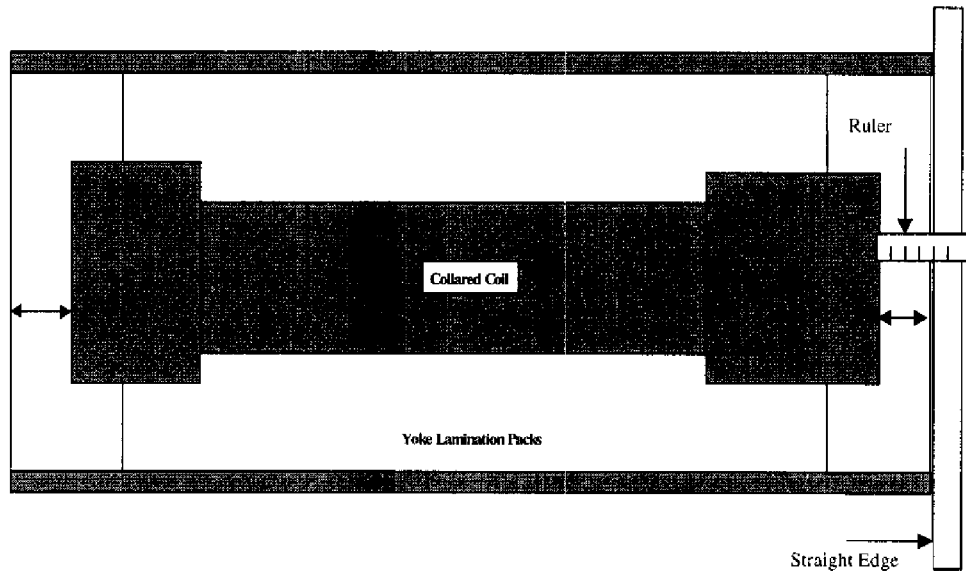
(Top View)

Lead Person

Date 10-31-01

9.0 Cold Mass Mechanical Inspection

- X 9.1 Measure the end of the Cold Mass Skin to End of the Saddles with a ruler to the closest 1/64". The nominal lengths are Lead End at 1.639" and Return End at 1.202" as per Skinned Yoke Assembly.



Quadrant	Lead End (Inch) 1+39/64" to 1+43/64"		Return End (Inch) 1+11/64" to 1+15/64"	
	Inner	Outer	Inner	Outer
#1	1.3245	1.333	1.15	1.4605
#2	1.3195 1.3490	1.353 1.3935	1.1355	1.4490
#3	1.3195	1.353	1.1045	1.438
#4	1.326	1.324	1.1380	1.4195

Inspector

Date

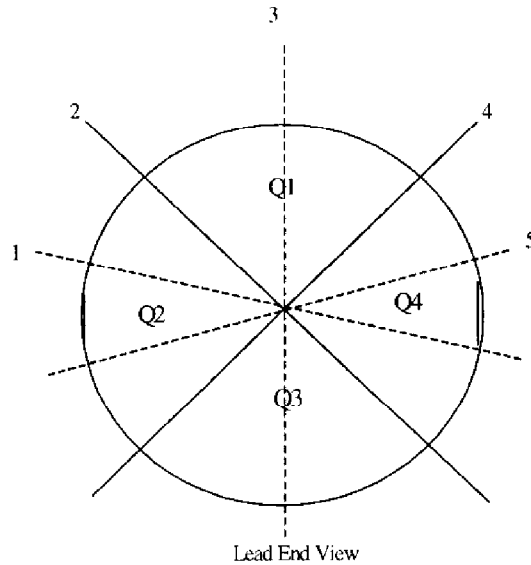
LHC Yoke & Skinning Assembly

Page 21 of 29

LHC Serial No. ~~MOXB01~~ *10-31-01*

MQXB01

- X 9.2 Final Outer Diameter Measurement with 0" to 24" caliper (Starrett S436KRLSZ) or equivalent to closest 0.001".



Distance from the Lead End	Position #1 5°	Position #2 45°	Position #3 90°	Position #4 135°	Position #5 175°
0" (LE)	16.502	16.368	16.336	16.363	16.489
50"	16.406	16.397	16.402	16.404	16.409
100"	16.406	16.403	16.409	16.409	16.402
150"	16.405	16.404	16.407	16.407	16.401
200"	16.397	16.399	16.411	16.411	16.405
240" (RE)	16.459	16.388	16.362	16.375	16.476

Inspector

Date

- 9.3 Twist check with MINILevel (#1045 or #75) or equivalent.

Note(s):

Ensure the MINILevel Selector Knob is in position #1.

Position	Angle 0.001mm/m=0.2sec	Position	Angle 0.001mm/m=0.2sec
0" (LE)	1.07	130"	1.14
10"	1.21	140"	1.33
20"	1.16	150"	1.03
30"	1.43	160"	1.62
40"	1.45	170"	1.18
50"	1.64	180"	1.44
60"	1.24	190"	1.17
70"	1.11	200"	1.50
80"	1.0	210"	1.58
90"	1.30	220"	1.02
100"	1.08	230"	1.32
110"	1.37	240"	
120"	1.18		

TAR # 1256
Should BE
mm/m = 2SEC
SNG
10/31/01

O. Finanza

Technician(s)

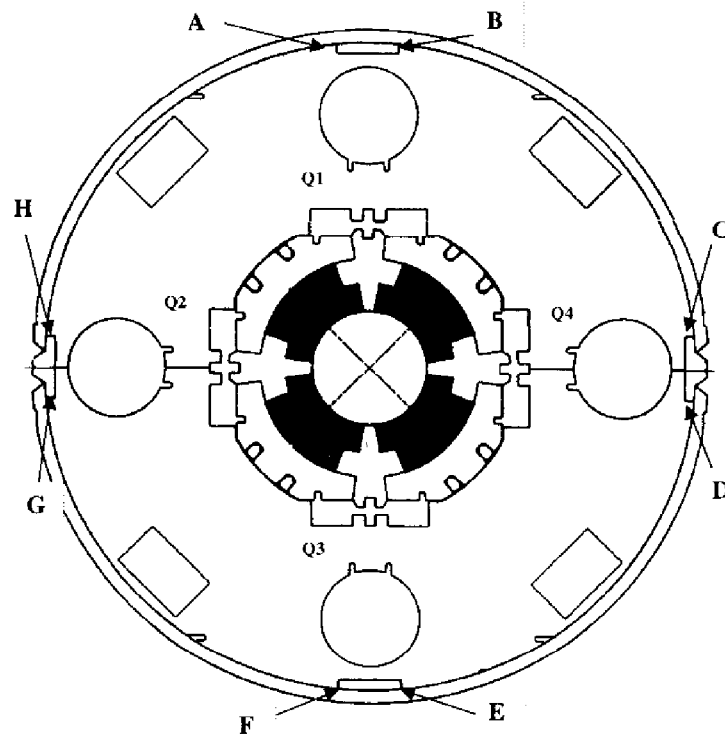
10/31/01
Date

- 9.4 Measure the Cold Mass Yoke Skin Assembly (ME-369404) from the Lead End of the Skin to the Return End of the Skin with a Standard Tape Measure. Record the Length from the Lead End of the Skin to the Return End of the Skin in the table below to the closest 1/32". The measurements are taken at the center of the Quadrants.

Position of the Measurement	Measurement in Inches
Q1	223 1/2
Q2	223 1/2
Q3	223 1/2
Q4	223 1/2

Technician(s)

Date



9.5 Measure the gap between the Lamination and the Skin to the side of the cutout

Position	Limit	Lead End	Return End
A	No Limit For Reference Only	Ø	Ø
B	No Limit For Reference Only	Ø	Ø
E	No Limit For Reference Only	Ø	Ø
F	No Limit For Reference Only	Ø	Ø

Technician(s)

Date

9.6 Measure the gap between the Lamination and the Key

Position	Limit	Lead End	Return End
C	No Limit For Reference Only	.001	Ø
D	No Limit For Reference Only	Ø	.002
G	No Limit For Reference Only	Ø	.002
H	No Limit For Reference Only	Ø	Ø

Technician(s)

Date

- 9.7 Perform an electrical inspection on each of the individual Inner Coils, Outer Coils, Quadrants and the Magnet. Refer to the Valhalla and Leader Free Standing Coil Measurement Procedure (ES-292306), and the Procedure for Electrical Inspection of Voltage Taps (ES-301383).

Note(s):

Ensure that all measurements are recorded correctly, and have the proper value and symbol (i.e., mΩ, mH, etc.).

Valhalla 4300B settings:

Test current	_____	Off (not testing)
Power	_____	On
Full scale voltage	_____	20mv
Amp selector knob	_____	1 A
Temperature compensator	_____	On
Test current	_____	On (testing)

Hp 4263 B:

Function _____ "Ls-Q" selected

Record the Serial Number of the test equipment used.

Valhalla 32-858

HP 4263b 2848J00912

Resistance		Inner	Outer	Total	Pass	Fail
Nominal		345 mΩ to 390 mΩ	410 mΩ to 455 mΩ	560 to 585 mΩ		
Quadrant 1	Inner	.2569 mΩ				
	Outer		.3179 mΩ			
	Total			.5748 mΩ		
Quadrant 2	Inner	.2564 mΩ				
	Outer		.3181 mΩ			
	Total			.5744 mΩ		
Quadrant 3	Inner	.2571 mΩ				
	Outer		.3190 mΩ			
	Total			.5760 mΩ		
Quadrant 4	Inner	.2576 mΩ				
	Outer		.3195 mΩ			
	Total			.5771 mΩ		

Inductance		Inner	Outer	Total	Pass	Fail
Nominal		620-650 μ H	1.120 to 1.17 mH	2.880 to 2.935 mH		
Quadrant 1	Inner	532.840 μ H				
	Outer		863.830 mH			
	Total			2.28856 528.460 mH		
Quadrant 2	Inner	528.460 μ H				
	Outer		857.698 mH			
	Total			2.28333 mH		
Quadrant 3	Inner	528.710 μ H				
	Outer		857.288 mH			
	Total			2.28435 mH		
Quadrant 4	Inner	531.840 μ H				
	Outer		861.477 mH			
	Total			2.28927 mH		

October 4, 2001

Rev. A

Q-Factor		Inner	Outer	Total	Pass	Fail
Nominal		3.0 to 3.5	4.3 to 5.0	4.5 to 5.2		
Quadrant 1	Inner	3.00				
	Outer		2.83			
	Total			4.77 4.69		
Quadrant 2	Inner	2.99				
	Outer		2.82			
	Total			4.70		
Quadrant 3	Inner	2.98				
	Outer		2.80			
	Total			4.66		
Quadrant 4	Inner	2.97				
	Outer		2.79			
	Total			4.64		

[Signature]
Inspector

10/11/01
Date

	Nominal	Measurements
Resistance	2.3 Ω	2.300 Ω
Q @ 1 kHz	4.3	5.08
Inductance(Ls) @ 1 kHz	17 mH	13.255 mH

[Signature]
Inspector

11/11/01
Date

Electrical Test	Limit	Actual Measurement	Pass	Fail
Heater Strips 1/2 Resistance	9.10 to 9.50 Ω	9.385 Ω	✓	
Heater Strips 2/3 Resistance	9.10 to 9.50 Ω	9.468 Ω	✓	
Heater Strips 3/4 Resistance	9.10 to 9.50 Ω	9.450 Ω	✓	
Heater Strips 4/1 Resistance	9.10 to 9.50 Ω	9.367 Ω	✓	

[Signature]
Inspector

11/11/01
Date

Perform a Hipot on the Collared Coil Assembly (Maximum Leakage 2.5 μ A)

5 KV	Measurement(s)
Heater #1/2 to Ground	.05 μ A
Heater #2/3 to Ground	.05 μ A
Heater #3/4 to Ground	.05 μ A
Heater #4/1 to Ground	.05 μ A
Heater #1/2 to All 4 Quadrants	.05 μ A
Heater #2/3 to All 4 Quadrants	.05 μ A
Heater #3/4 to All 4 Quadrants	.05 μ A
Heater #4/1 to All 4 Quadrants	.05 μ A
All 4 Quadrants to Ground	.04 μ A

Coil to Coil 3.0 KV	Measurement(s)
Quadrant 1 to Quadrant 2	.05 μ A
Quadrant 2 to Quadrant 3	.05 μ A
Quadrant 3 to Quadrant 4	.05 μ A
Quadrant 4 to Quadrant 1	.05 μ A

Inspector

Date



- 9.8 Verify that the results in Step 9.7 are acceptable.
Approved for next Assembly Procedure.

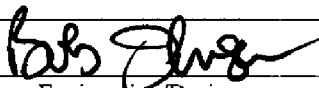
Responsible Authority/Physicist

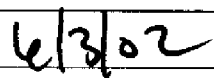
Date

10.0 Production Complete

- 10.1 Process Engineering verify that the LHC Yoke/Skinning Traveler (TR-333497) is accurate and complete. This shall include a review of all steps to ensure that all operations have been completed and signed off. Ensure that all Discrepancy Reports, Nonconformance Reports, Repair/Rework Forms, Deviation Index and dispositions have been reviewed by the Responsible Authority for conformance before being approved.

Comments:


Process Engineering/Designee


Date

PARTS KIT REQUEST

1) MAGNET NUMBER MUST BE FILLED IN.

- 1) MAGNET NUMBER MUST BE FILLED IN.
- 2) ONLY ONE FORM PER MAGNET.
- 3) PARTS COORDINATOR OR DESIGNEE MUST SIGN THIS FORM.
- 4) MATERIAL CONTROL WILL ISSUE PARTS AND RECORD ROUTING NUMBER.
- 5) ANY QUANTITIES NOT AVAILABLE WILL HAVE COMMENTS RETURNED TO THE PARTS COORDINATOR FOR REVIEW.

BUDGET CODE: LQC

ME-369579	A	SKINNED YOKE ASSEMBLY
-----------	---	-----------------------

[illegible]

TR-333497

KIT IS COMPLETE (PARTS COORDINATOR SIGNATURE):

BADGE # 4569

STOCKROOM SIGNATURE AND DATE

DATE JUN 10

Page 1 of 1

ORIGINAL

ISSUE VERIFICATION	MATERIAL CONTROL SIGNATURE: <i>Wanda Feldman</i>	DATE ISSUED TO STOCKROOM: <i>6/24/01</i>
TODAYS DATE:	15-Jun-01	
	NEED DATE: <i>25-Jun-01</i>	
RELEASED BY		
MAGNET NUMBER: <i>001</i> MQXB0000		
PRODUCTION SIGNATURE: T J Gardner		

February 1, 2002

Rev. K

Traveler Title:

LHC Yoke & Skinning Traveler

Specification No:

5520-TR-333497

Revision:

A

DR No:

HGQ-0262

Step No:

4.6

Drawing No:

ME-369579

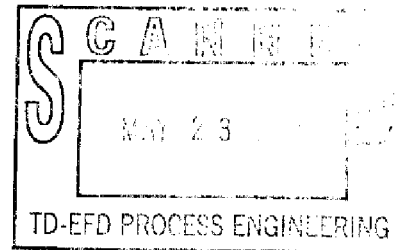
Routing Form No:

Serial No:

MQXB01

Discrepancy Description:

Step dictates to install yoke packs into assembly with a 1.650" gap between the straight section yoke pack and non-lead end yoke stack for routing wires. This assembly does not have any wires that need to be routed through this gap as in previous assemblies.



Originator:

Jim Rife

Date:

10/17/01

Cause of Nonconformance:

Prototype yoke design has been carried onto the production magnet.

Responsible Authority:

Rodger Bossert

Date:

12/11/01

Disposition:

Add loose stainless steel laminations to gap (9 laminations) and continue.

Responsible Authority:

Rodger Bossert

Date:

12/11/01

Corrective Action to Prevent Recurrence:

Change drawing to add stainless steel laminations to Non-Lead End Yoke Pack. Traveler will need to have drawing number for Non-Lead End Pack changed. New Drawing No. (MD-369828). (TRR No. 1283 - John Szostak 3/14/02)

Responsible Authority:

Rodger Bossert

Date:

12/11/01

Corrective Action/Disposition Verified By:

Rodger Bossert

Date:

12/11/01

Will Configuration be affected?:

☒ YES

☐ NO

Identified problem area:

☐ Material

☐ Manpower

☒ Method

☐ Machine

☐ Measurement

Reviewed By:

Bob Jensen

Date:

5/22/02

Traveler Title:

LHC Yoke & Skinning Traveler

Specification No:

5520-TR-333497

Revision:

A

DR No:

HGQ-0263

Step No:

7.22

Drawing No:

5520-ME-369579

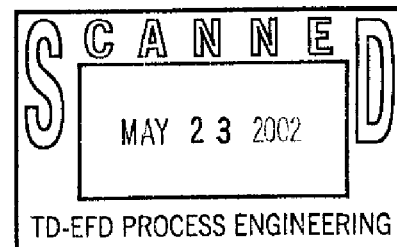
Routing Form No:

Serial No:

MQXB01

Discrepancy Description:

A sixth pass of weld was added to the cold mass.



Originator:

Steve Gould

Date:

10/26/01

Cause of Nonconformance:

Traveler calls for five passes. Six passes were needed to fill grooves on this magnet.

Responsible Authority:

Rodger Bossert

Date:

10/26/01

Disposition:

Continue with magnet.

Responsible Authority:

Rodger Bossert

Date:

10/26/01

Corrective Action to Prevent Recurrence:

Change traveler to allow for more than five passes, as needed. Allow operator to note the number of passes up to six without violating the procedure. (TRR No. 1255 - John Szostak 3/14/02)

Responsible Authority:

Rodger Bossert

Date:

10/26/01

Corrective Action/Disposition Verified By:

Rodger Bossert

Date:

10/26/01

Will Configuration be affected?:

☒ YES

☐ NO

Identified problem area:

☐ Material

☐ Manpower

☒ Method

☐ Machine

☐ Measurement

Reviewed By:

Bob Jensen

Date:

5/22/02

Traveler Title:

LHC Yoke & Skinning Traveler

Specification No:

5520-TR-333497

Revision:

A

DR No:

HGQ-0268

Step No:

9.7

Drawing No:

ME-369579

Routing Form No:

Serial No:

MQXB01

Discrepancy Description:

During the hipotting procedure of coil to ground, the magnet shorted out at 4 KV. It was determined that the Q3 ramp splice tap was shorting to the end can.

Originator:

Steve Gould

Date:

11/1/2001

Cause of Nonconformance:

The 1/8 Coil tap in Q3 was shorting to the interior surface of the Lead End Can where it had been spliced. The wire is routed in a groove in the exterior surface of the G-11 Collet.

Responsible Authority:

Rodger Bossert

Date:

11/1/2001

Disposition:

Fix short by surrounding spliced area with a kapton tube, then slide it into the slot ground into the collet. Fill the space with green putty.

Responsible Authority:

Rodger Bossert

Date:

11/1/2001

Corrective Action to Prevent Recurrence:

Use kapton tubes in MQXB02. After MQXB02, these taps (1/8 coil taps) will no longer be used.

Responsible Authority:

Rodger Bossert

Date:

11/1/2001

Corrective Action/Disposition Verified By:

Rodger Bossert

Date:

11/1/2001

Will Configuration be affected?:☐ YES☒ NO**Identified problem area:**☐ Material☐ Manpower☐ Method☐ Machine☒ Measurement**Reviewed By:**

Bob Jensen

Date:

11/8/2001

Revision Request Control Number: 1252

Specification Number: 5520 - TR - 333497

Current Revision: A

Traveler or Document Title LHC Yoke & Skinning Traveler

Step #/Description of Revision:

- 4.6 Modified Step. Added "Ensure all yoke packs are in contact, excluding the 1/4" gap." to step and Note(s) section.
Adjusted diagram to show 1/4" gap.
- 4.7 Modified Step. Remove "... the Strain Gauge Wires and ..." from Step.
- 5.3 Modified picture. Adjusted diagram to show 1/4" gap.

Damon Bice

Originator

Jim Rife

Responsible Authority

10/16/2001

Date

Revision Incorporated into the Traveler:

John Szostak

Revision Incorporated By

3/20/2002

Date

Process Engineering Final Review:

Bob Jensen

Process Engineering/Designee

3/20/2002

Date

Instructions for the completion of the Revision Request Form**Note(s):**

Multiple steps may be effected by one Revision Request Form but only one specific Traveler or Document may be effected by each Revision Request Form.

If completing this form by hand, a Revision Request Control Number must be obtained before processing.

If completing this form entirely by electronic means, the printed copy to be filed in the Process Engineering Office is to be initiated by the individual incorporating the Revision Request and the individual who reviewed the Traveler or Document.

Originator Instructions:

- 1) Specification Number: - Enter the Specification Number of the Traveler or Document to be revised. (Document title is inserted automatically from the spec. #)
- 2) Current Revision: - Enter the Revision of the Traveler or Document to be revised.
- 3) Step# / Description of the Revision: - Enter a description of the revision to be made and the step# it applies to, if applicable. If needed to describe the revision attach a copy of the page(s). If the revision is coming from a related document such as a Discrepancy Report or an Engineering Order attach a copy of that document to the Revision Request Form.
- 4) Originator: - Originator is the person generating the form. (Select Name from List)
- 5) Responsible Authority: - Responsible Authority is person responsible for the process in question. (Select Name from List)

Process Engineering Office Instructions:

- 1) Revision Incorporated into the Traveler: - Signature of the individual who incorporated the revision.
- 2) Process Engineering Final Review: - Review the Traveler or Document revised, sign and date the form. The original completed Revision Request Form will be retained by the Process Engineering Office in the Revision Request Binder.

Revision Request Control Number: 1255

Specification Number: 5520 - TR - 333497

Current Revision: A

Traveler or Document Title LHC Yoke & Skinning Traveler

Step #/Description of Revision:

- 3.1 Modified Step. Added "Modify the Lengths of the Keys to fit."
7.20 Added Step. "Inspect the Welds and determine if a 6th pass is necessary." DR No. HGQ-0263.
9.1 Added Step. "Install the Jumper Wires (length as required) (MA-369833) on the Heater Strips at the NON-Lead End as per Figure 1." (Old Step 3.1 of 333498)
9.2 Added Step. "Install Saddle Shim Stock (MA-369817) Outer pieces (Qty. 4) into the four quadrants. Modify as necessary to fit properly."

Jim Rife

Originator

Jim Rife

Responsible Authority

12/4/2001

Date

Revision Incorporated into the Traveler:

John Szostak

Revision Incorporated By

3/20/2002

Date

Process Engineering Final Review:

Bob Jensen

Process Engineering/Designee

3/20/2002

Date

Instructions for the completion of the Revision Request Form**Note(s):**

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Process Engineering Office Instructions:

- 1) **Revision Incorporated into the Traveler:** - Signature of the individual who incorporated the revision.
- 2) **Process Engineering Final Review:** - Review the Traveler or Document revised, sign and date the form. The original completed Revision Request Form will be retained by the Process Engineering Office in the Revision Request Binder.

Revision Request Control Number: 1256

Specification Number: 5520 - TR - 333497

Current Revision: A

Traveler or Document Title LHC Yoke & Skinning Traveler

Step #/Description of Revision:

- 6.2 Modified Step. Updated nominals. R=2.305 W, Q=5.036, Ls=13.3376 mH.
6.5 Modified Step. Added " Tack Weld at every other Press Column, beginning with the First Column at Lead End."
Changed Technician signature to Weldor.
6.6 Modified Step. Updated nominals. R=2.305 W, Q=5.036, Ls=13.3376 mH.
7.24 Modified Step. Updated nominals. R=2.305 W, Q=5.036, Ls=13.3376 mH.
9.3 Modified Table. Changed the Angle Header Column from "mm/m = 0.2 sec." to "mm/m = 2 sec".
10.1 Modified Step. Updated nominals. R=2.305 W, Q=5.036, Ls=13.3376 mH.

Jim Rife

Originator

Jim Rife

Responsible Authority

10/18/2001

Date

Revision Incorporated into the Traveler:

John Szostak

Revision Incorporated By

3/20/2002

Date

Process Engineering Final Review:

Bob Jensen

Process Engineering/Designee

3/20/2002

Date

Instructions for the completion of the Revision Request Form

Note(s):

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Revision Request Control Number: 1257

Specification Number: 5520 - TR - 333497

Current Revision: A

Traveler or Document Title LHC Yoke & Skinning Traveler

Step #/Description of Revision:

- 4.6 Modified Step. Named Specified Lifting Device, "Iron Core Transport Fixture Assembly (ME-344634)".
4.7 Modified Step. Named Specified Lifting Device, "Iron Core Transport Fixture Assembly (ME-344634)".
5.3 Modified Step. Named Specified Lifting Device, "Iron Core Transport Fixture Assembly (ME-344634)".
5.4 Modified Step. Named Specified Lifting Device, "Iron Core Transport Fixture Assembly (ME-344634)".

Jim Rife

Originator

Jim Rife

Responsible Authority

10/18/2001

Date

Revision Incorporated into the Traveler:

John Szostak

Revision Incorporated By

3/20/2002

Date

Process Engineering Final Review:

Bob Jensen

Process Engineering/Designee

3/20/2002

Date

Instructions for the completion of the Revision Request Form

Note(s):

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Originator Instructions:

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- 3) Step# / Description of the Revision: - Enter a description of the revision to be made and the step# it applies to, if applicable. If needed to describe the revision attach a copy of the page(s). If the revision is coming from a related document such as a Discrepancy Report or an Engineering Order attach a copy of that document to the Revision Request Form.
- 4) Originator: - Originator is the person generating the form. (Select Name from List)
- 5) Responsible Authority: - Responsible Authority is person responsible for the process in question. (Select Name from List)

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Revision Request Control Number: 1283

Specification Number: 5520 - TR - 333497

Current Revision: A

Traveler or Document Title LHC Yoke & Skinning Traveler

Step #/Description of Revision:

- 4.4 Modified Step. Added "Straight Section Yoke Pack - Non - Lead End MD-369828" to the Table. DR. No. HGQ-0262.
- 4.6 Modified Step. Changed to "Using the Iron Core Transport Fixture Assembly (ME-344634), insert the five Lower Yoke Packs into the Bottom Skin in accordance with the Skinned Yoke Assembly (ME-369579). Ensure all yoke packs are in contact, excluding the 1/4" gap. 1) Lead End Yoke Stack (MD-369587) 2) Lead End Straight Section Yoke Stack (MD-369588) 3) Straight Section Yoke Stack (MD-369727) 4) Straight Section Yoke Stack - Non-Lead End (MD-369828) 5) Non-Lead End Yoke Stack (MD-369589)." Changed Drawing to Show New Straight Section Yoke Pack (MD-369828), 9 Stainless Steel Laminations at the Lead End and 21 Stainless Steel Laminations at the Return End. DR. No. HGQ-0262.
- 4.7 Modified Step. Changed Drawing to Show New Straight Section Yoke Pack (MD-369828), 9 Stainless Steel Laminations at the Lead End and 21 Stainless Steel Laminations at the Return End. DR. No. HGQ-0262.
- 4.8 Added Step. "Transfer the Magnetic Center mark to the outside of the Lower Skin." DR No. HGQ-0265.
- 4.9 Added Step. "Verify the Magnetic Center Mark on the outside of the Lower Skin is correct." DR No. HGQ-0265.
- 4.12 Modified Step. Changed signoff from Inspector to Crew Chief.
- 5.1 Modified Step. Changed to "Clean the Upper Yoke Packs ..." Added "Straight Section Yoke Pack - Non - Lead End MD-369828" to the Table.
- 5.3 Modified Step. Changed Drawing to Show New Straight Section Yoke Pack (MD-369828), 9 Stainless Steel Laminations at the Lead End and 21 Stainless Steel Laminations at the Return End. DR. No. HGQ-0262. Changed Note from "...Top Lead End ..." to "...Upper Lead End..."
- 5.4 (New) Added Step. "Install Loose Laminations from the Face of the Magnet to 113" from Magnetic Center. Install Filler Packs to the End of the Skin."
- 5.4 Modified Step. Corrected "...Bottom Yoke Lamination/Skin Assembly." to "...Upper Yoke Lamination/Skin Assembly."
- 7.23 Added Step. Moved old step 8.1 to new location as Step 7.23.
- 8.1 - 8.17 Modified Steps. Modified multiple steps for Skin Cutting procedure.
- 9.7 Modified Step. Added Note "Note(s): Ensure Assembly is isolated from ANY Ground."
- 10.0 Modified Step. Changed Numbering. Moved Electrical Inspection to 10.1 and Verification to 10.2.

Jim Rife

Originator

Jim Kerby

Responsible Authority

1/10/2002

Date

Revision Incorporated into the Traveler:

John Szostak

Revision Incorporated By

3/20/2002

Date

Process Engineering Final Review:

Bob Jensen

Process Engineering/Designee

3/20/2002

Date

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